

Chapter 1

Part 1

Biology: Exploring Life



PowerPoint Lectures for
Biology: Concepts & Connections, Sixth Edition
Campbell, Reece, Taylor, Simon, and Dickey

Lecture by Dr. Fernando Prince

Important Terms

Biology is the study of life.

- **Evolution**

- Literally means to change. These changes to life or **adaptations** are then tested by the environment, for better or worst. This is the process of change that ultimately transforms life.

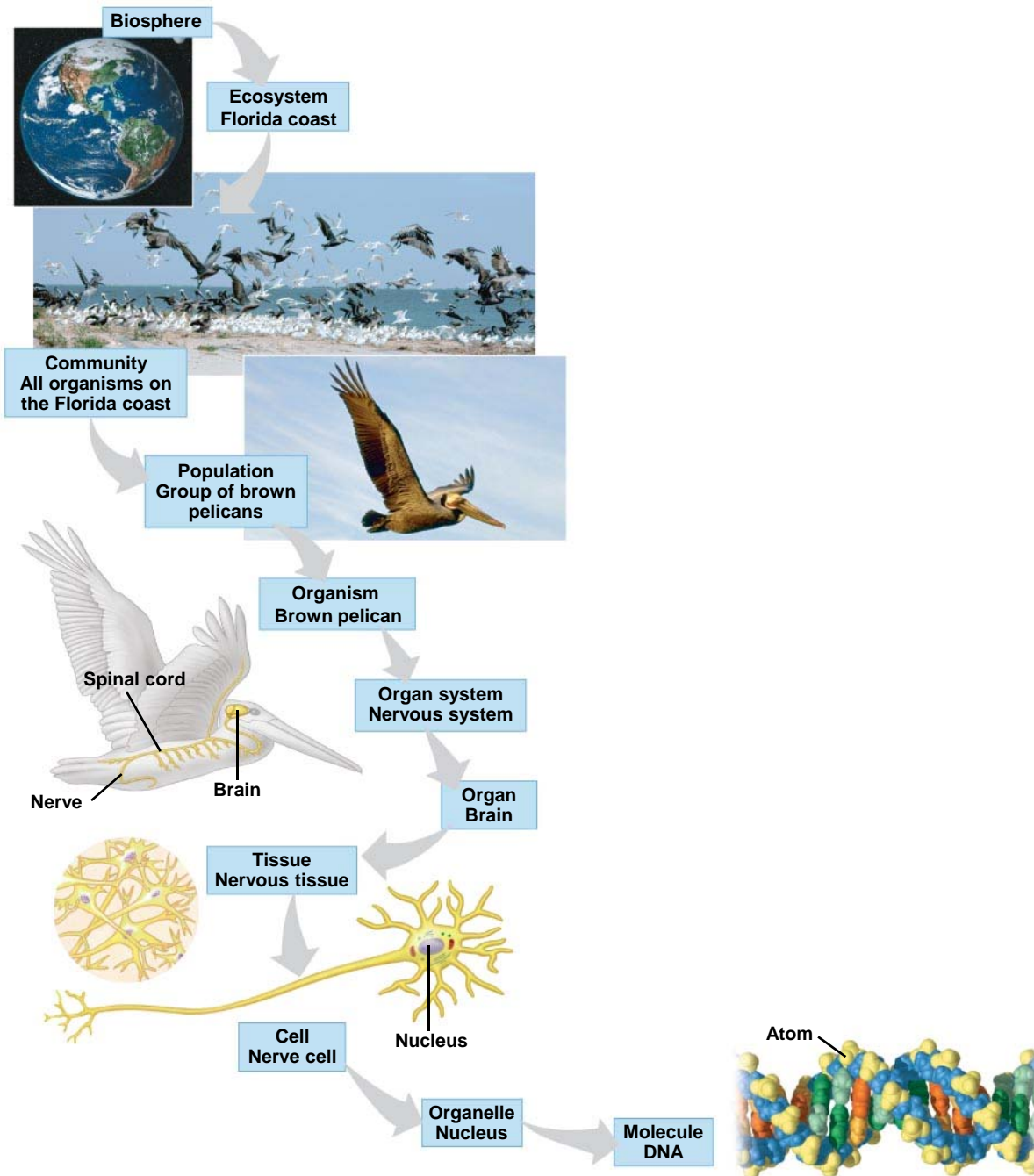
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1.1 In life's hierarchy of organization, new properties emerge at each level

- Life is organized!
- Life's levels of organization start simple and progress toward greater complexity.
 - At each level of organization a new or novel property emerges these properties are called **emergent properties**.

The levels of structural organization are (simple to complex) Atomic, Molecular, Organelle, **cell**, **Tissue**, **Organ**, **Organ system**, **Organism**, Population, Community, Ecosystem, Biosphere.

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1.1 In life's hierarchy of organization, new properties emerge at each level

- **Molecules**—clusters of atoms
- **Organelles**—membrane-bound structures with specific functions
- **Cells**—Life emerges, entities distinguished from their environment by a membrane
- **Tissues**—made of groups of similar cells
- **Organs**—provide specific functions for the organism
- **Organ systems**—have specific functions; are composed of organs
- **Organism**- an individual member of a population
- **Population**—all the individuals of a species within a specific area
- **Community**—the array of organisms living in a particular ecosystem
- **Ecosystem**—all the organisms living in a particular area
- **Biosphere**—all the environments on Earth that support life

1.2 Living organisms interact with their environments, exchanging matter and energy

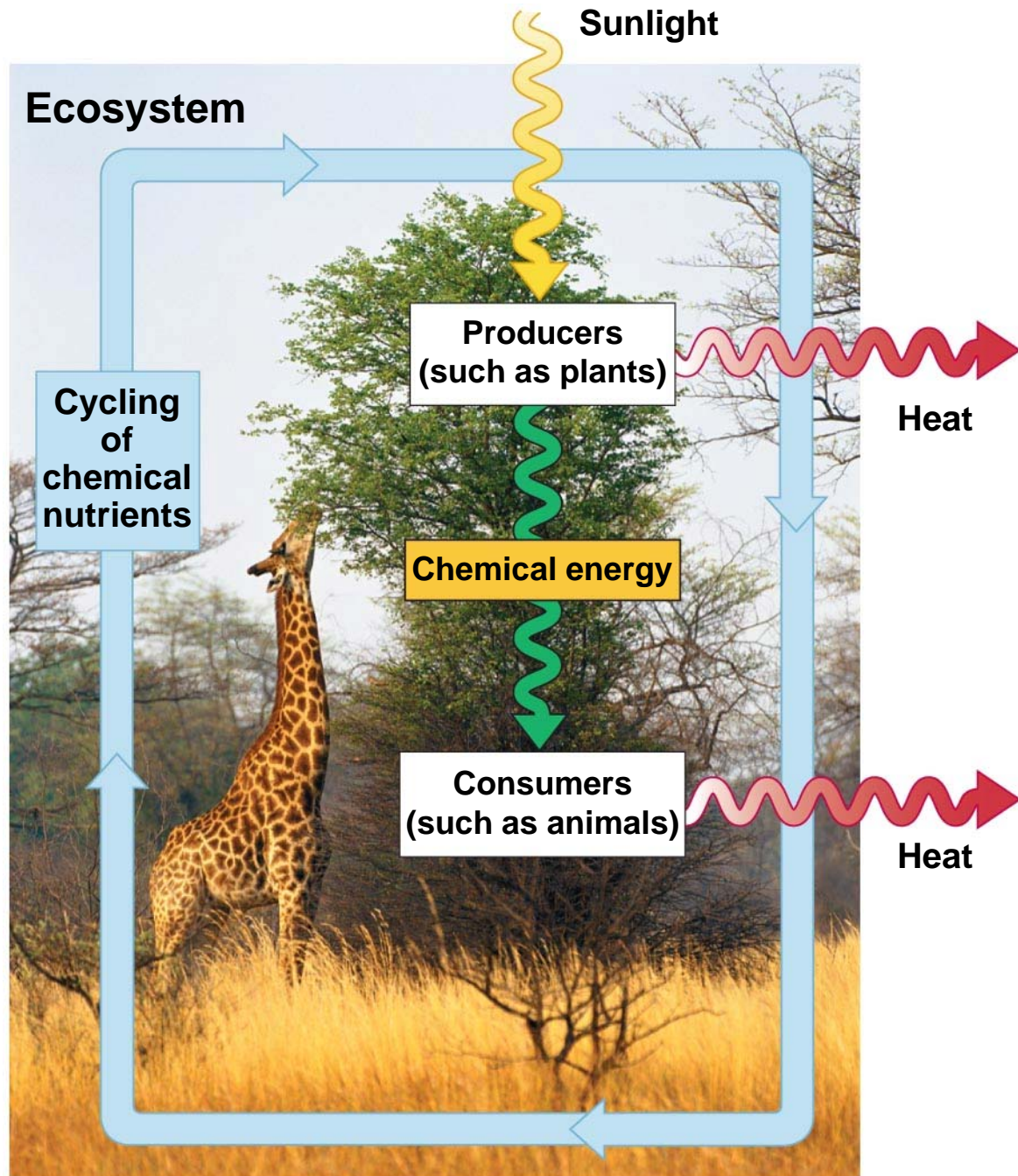
- Life requires energy to maintain its organization. Energy is acquired from the sun or from the chemical bonds found in molecules.
- Organisms that acquire their energy directly from the sun through the process of photosynthesis are called **producers**.
- Organisms that acquire their energy by consuming producers and/or other consumers are called **consumers**.

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1.2 Living organisms interact with their environments, exchanging matter and energy

- On this bubble of life we call Earth, only energy is not recycled.
- Because Earth is a closed environment (the only imports are in the form of meteorites) all of our chemicals from Carbon to water are, have been, and will continue to be recycled.
- Energy on the other hand is imported continuously from the Sun. Energy in the form of **light** is captured by producers, passed along to consumers, and eventually escapes as **Heat**.

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1.3 Cells are the structural and functional units of life

- The **Principle of Complementarity** states that function and form are intimately interdependent.
 - By studying a structure, you can determine what it does and perhaps even how it works.
 - At every level of structural organization form and function are intimately related. Atoms of an element react in a specific way because of their structure and organisms carry out their life activities because of their structure.
 - Function follows form!

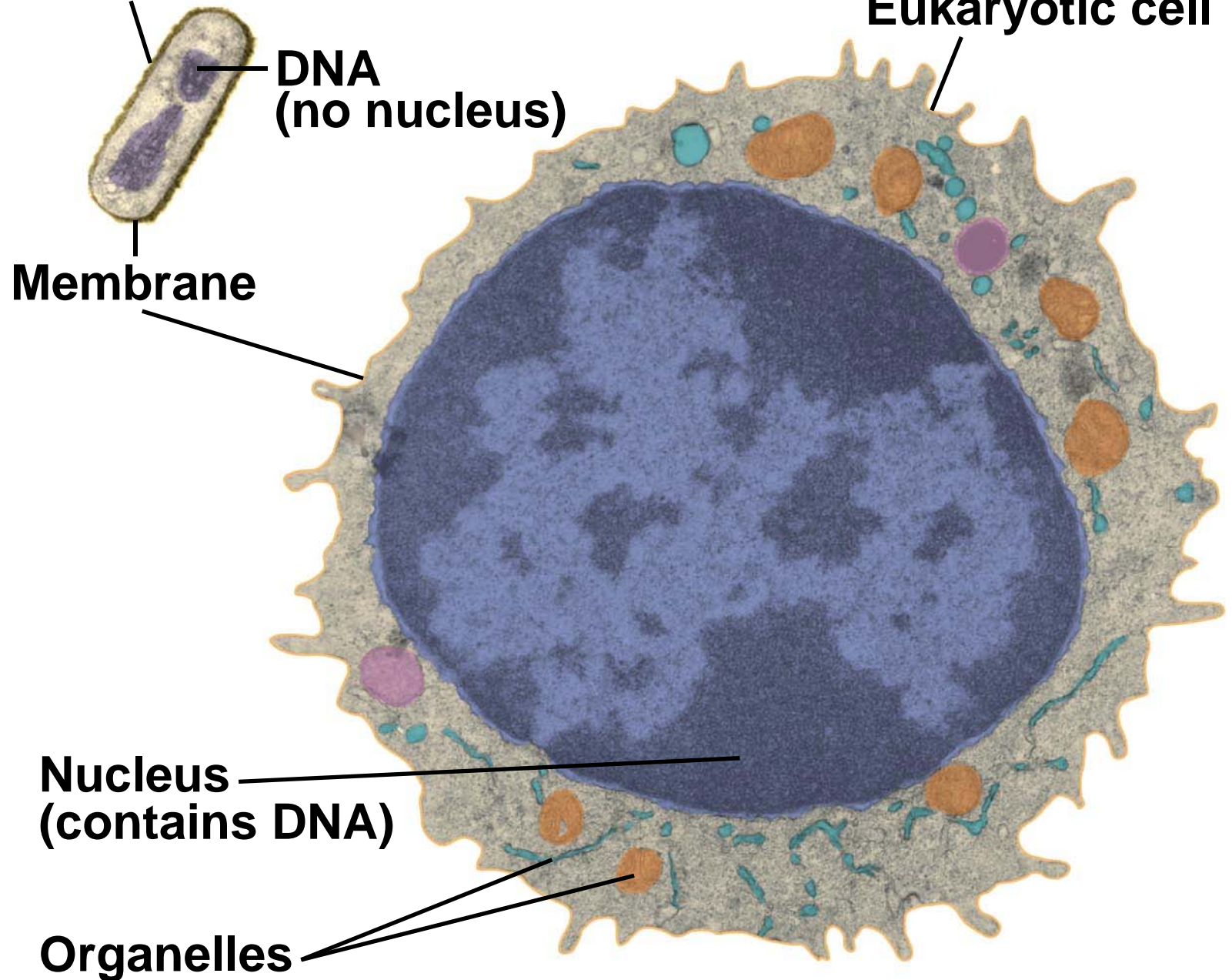
1.3 Cells are the structural and functional units of life

- There are two distinct groups of cells
 - **Prokaryotic cells** – These have no membrane bound organelles such as the nucleus
 - Simple and small
 - Bacteria are prokaryotic
 - **Eukaryotic cells** – These have membranous organelles such as a nucleus. The use membranes lead to greater complexity of the cell through compartmentalization.
 - Possess organelles separated by membranes
 - Plants, animals, and fungi are eukaryotic

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Prokaryotic cell

Eukaryotic cell



**DNA
(no nucleus)**

Membrane

**Nucleus
(contains DNA)**

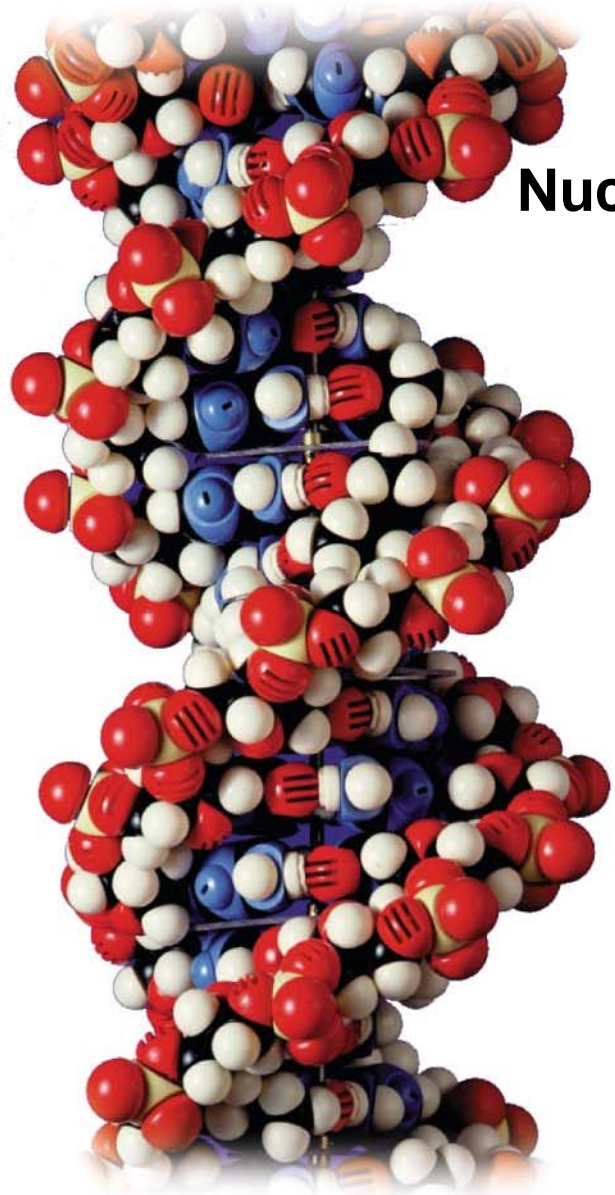
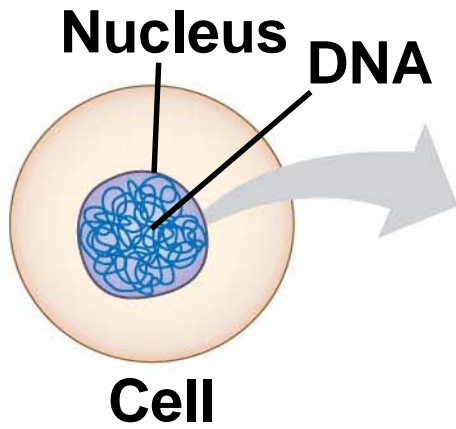
Organelles

EVOLUTION, THE CORE THEME OF BIOLOGY

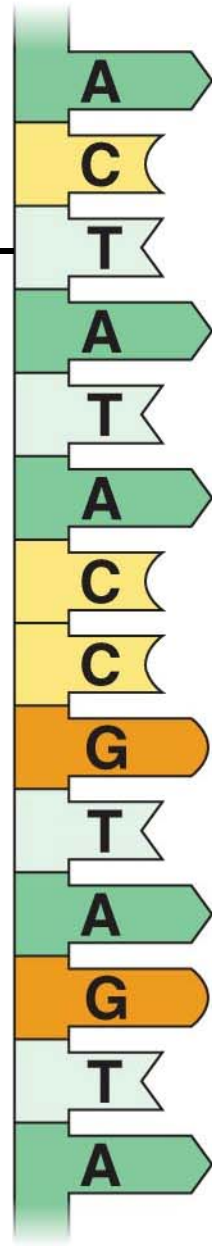
1.4 The unity of life: All forms of life have common features

- DNA is the genetic (hereditary) material of all living things
 - A **gene** is a discrete unit or segment of DNA that encodes for a specific protein.
 - The structure of DNA for simple method of information storage that is stable and yet flexible enough to allow for the mutations that drive evolution.
 - Life's diversity resulted from the accumulation of changes in DNA. Those changes that were able to overcome the environmental challenges are the fittest in "survival of the fittest".

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Nucleotide



(a) DNA double helix

(b) Single strand of DNA

1.4 The unity of life: All forms of life have common features

–**Order**—the complex organization of living things



(1) Order

1.4 The unity of life: All forms of life have common features

–**Regulation**—an ability to maintain an internal environment consistent with life



(2) Regulation

1.4 The unity of life: All forms of life have common features

–**Growth and development**—consistent growth and development controlled by DNA

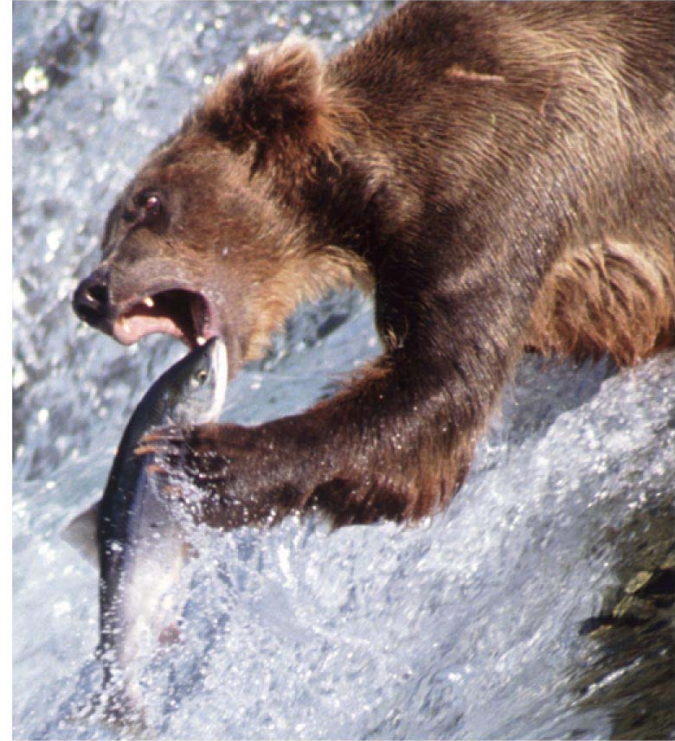


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(3) Growth and development

1.4 The unity of life: All forms of life have common features

–**Energy processing**—acquiring energy and transforming it to a form useful for the organism

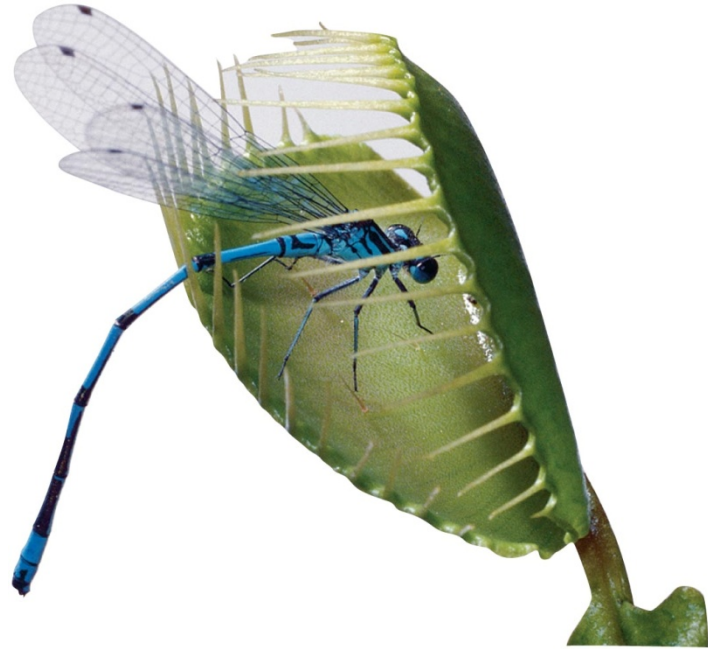


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(4) Energy processing

1.4 The unity of life: All forms of life have common features

–**Response to the environment**—an ability to respond to environmental stimuli



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(5) Response to the environment

1.4 The unity of life: All forms of life have common features

–**Reproduction**—the ability to perpetuate the species

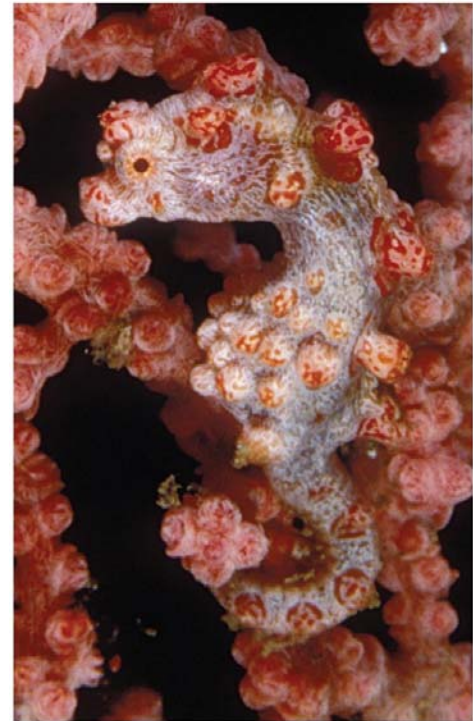


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(6) Reproduction

1.4 The unity of life: All forms of life have common features

–**Evolutionary adaptation**—acquisition of traits that best suit the organism to its environment



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(7) Evolutionary adaptation

1.5 The diversity of life can be arranged into three domains

- The three domains (groups) of life
 - **Bacteria**—prokaryotic, and most are unicellular and microscopic
 - **Archaea**—like bacteria, are prokaryotic, and most are unicellular and microscopic
 - **Eukarya**—are eukaryotic and contain a nucleus and organelles

Domain Eukarya

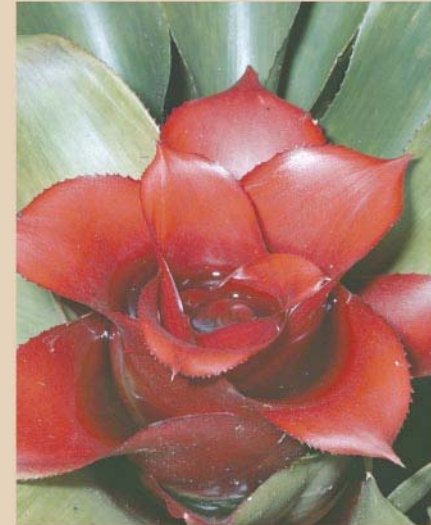
Domain Bacteria



Bacteria (multiple kingdoms)



Protists (multiple kingdoms)



Kingdom Plantae

Domain Archaea



Archaea (multiple kingdoms)



Kingdom Fungi



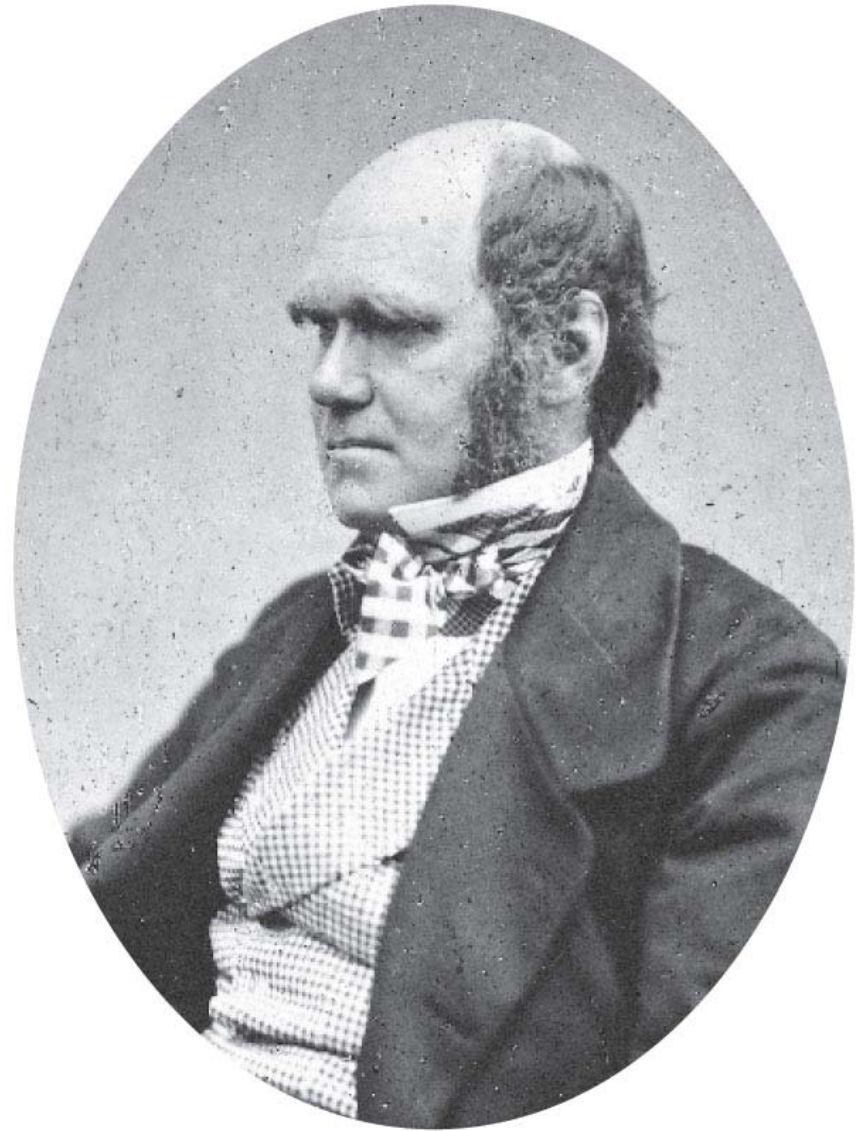
Kingdom Animalia

1.6 Evolution explains the unity and diversity of life

- In 1859, Charles Darwin published *On the Origin of Species by Means of Natural Selection*
 - The book accomplished two things
 - Presented evidence to support the idea of **evolution**
 - Proposed a mechanism for evolution called **natural selection**



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1.6 Evolution explains the unity and diversity of life

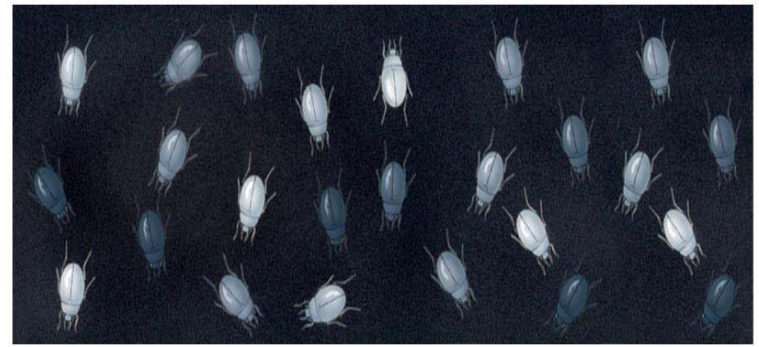
- Natural selection was inferred by connecting two observations
 - Individuals within a population are slightly different from each other.
 - More individuals are born than can survive leading to competition and “survival of the fittest”.

1.6 Evolution explains the unity and diversity of life

- Natural selection is an editing mechanism
 - Exposing a variety of genetic individuals to the environment results in some being favored over others.
 - With time this results in the creation of new species adapted to environments that are subject to change.
 - **Evolution** is biology's core theme and explains unity and diversity of life
 - Evolution is understood by our unity and our diversity is understood by evolution.

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A population with genetic diversity



**The environment (the dark background and
The hungry birds select the light colored bugs
For elimination.**



**Only the survivors are allowed by the
Environment to continue to reproduce
And pass on their genetic traits.**

**So it is the environment that selects
Who dies and who lives.**



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